

# The Agency's Response to the Accident at TEPCO's Fukushima Daiichi Nuclear Power Plant

The accident at Tokyo Electric Power Company's (TEPCO's) Fukushima Daiichi nuclear power plant (hereinafter the 'Fukushima Daiichi accident'), following the devastating earthquake and tsunami that struck Japan in March 2011, brought nuclear safety to the forefront of global attention. It underlined the responsibility of Member States and operating organizations in this crucial area.

This chapter briefly describes the Agency's response to the accident. It is based to a large extent

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on the *Nuclear Safety Review for 2012*, which provides a more detailed description of the accident and the range of the response actions to it.

## Background

On 11 March 2011, an earthquake of magnitude 9.0 and a subsequent tsunami with an unprecedented run-up height reported to be approximately 14 m occurred off the east coast of Honshu, Japan. The Tokai, Higashi Dori, Onagawa, and Fukushima Daiichi and Daini nuclear power facilities were affected by severe ground motion and multiple large tsunami waves. The operational units at these facilities were successfully shut down by the automatic systems. However, the large tsunami waves affected these facilities to varying degrees, with the most serious consequences occurring at the Fukushima Daiichi nuclear power plant. About 46 minutes after the earthquake, the first of a series of large tsunami waves reached the site and overran the 5.7 m sea wall designed to protect it.

The tsunami inundated the Fukushima Daiichi site, causing the loss of all power sources except

for one emergency diesel generator. With no other significant power source available on-site or off-site, the ability to cool the reactors was completely lost. The operators faced a catastrophic and unprecedented emergency scenario, with no power, no reactor control, almost no instrumentation and severely disrupted communications systems. They had to work in darkness to secure the safety of six reactors, six associated fuel pools, a common fuel pool and dry cask storage facilities.

Without backup power, venting and seawater injections could not alleviate the resulting lack of cooling to the active fuel and spent fuel pools. The reactor temperature increased and eventually led to hydrogen explosions at Units 1, 3 and 4, considerably damaging or destroying portions of these reactor buildings; fuel damage was suspected in Units 1, 2 and 3. On 12 April 2011, the Japanese Nuclear and Industrial Safety Agency (NISA) rated the event as Level 7 on the IAEA-OECD/NEA International Nuclear and Radiological Event Scale (INES).<sup>1</sup>

As a result of the release of a wide spectrum of radionuclides to the environment, a large number of people had to be evacuated from the area in order to prevent exposures above predefined reference levels. The Government of Japan established a restricted area of 20 km radius and planned evacuation zones. An emergency evacuation preparedness zone was established between a 20 and 30 km radius, and a deliberate evacuation area was also identified extending beyond the 30 km radius.

The assessment of exposures to the population and the environment, in particular in the Fukushima area, is the subject of studies being carried out by WHO and UNSCEAR, respectively, with the support and involvement of the Agency.

In mid-December 2011, conditions at the Fukushima Daiichi nuclear power plant had improved and stabilized. Plant operators brought the reactors into a "cold shutdown condition".

<sup>1</sup> See *INES: The International Nuclear and Radiological Event Scale User's Manual: 2008 Edition*, IAEA, Vienna (2009).

## The Agency's Response in the Aftermath of the Accident

Following the accident, the Agency's Incident and Emergency Centre (IEC) was placed in 'full response mode', operating 24 hours a day, 7 days a week, from 11 March to 3 May 2011. Designated Agency staff, notably liaison officers, public information officers, emergency response managers, logistics officers, technical specialists, and communication specialists, among others, were called in to discharge critical functions at the IEC.

The Agency kept Member States informed of the evolving situation, promptly notified all international organizations, activated the Joint Radiation Emergency Management Plan of the International Organizations, and began coordinating the inter-agency response to the Fukushima Daiichi accident with regard, in particular, to reaching a common understanding of the accident situation and coordinating public information.

From the early days after the accident, the Director General consulted with the Director General of WHO, the Director General of FAO, the Executive Secretary of the CTBTO and the Secretary General of WMO for effective coordination of activities.

At the first coordination meeting of the Inter-Agency Committee on Radiological and Nuclear Emergencies (IACRNE), relevant international organizations were briefed on the status of the situation, information was exchanged, response activities were coordinated and the public was kept informed through joint press releases.

The Director General visited Tokyo to obtain first-hand information on the accident, to pledge the Agency's full support and expert assistance, and to convey offers of assistance from more than a dozen countries. He met with Japanese Prime Minister Naoto Kan and the Minister of Foreign Affairs, Takeaki Matsumoto, along with senior officials from TEPCO and NISA. He stressed the importance of providing timely official information to the Agency and of maintaining the highest level of transparency.

The Agency sent four radiological monitoring teams to Japan to help validate the results of more extensive measurements made by the Japanese authorities. The Agency also sent a boiling water reactor expert team to Japan for detailed technical discussions with the relevant Japanese authorities.

In view of the accident's progression, the Agency evaluated key issues relating to the accident, coordinated responses, and provided accurate and

timely information to Member States, the media and the public. Through its Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture and its laboratories in Seibersdorf, Austria, the Agency gathered and presented food contamination and monitoring data in areas affected by the Fukushima Daiichi accident. The database currently includes more than 100 000 entries based on information provided by the Japanese authorities. In addition, a Joint FAO/IAEA Food Safety Assessment Team

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went to Japan in March 2011 to provide advice and assistance to the Japanese authorities on food safety and monitoring strategies.

The Agency's Laboratories in Seibersdorf provided analysis, information and methodological advice to laboratories from the ALMERA network.<sup>2</sup> These in turn carried out spectroscopic measurements on nearly 100 samples taken in Japan during various Agency missions.

Because Japan has a very high marine food consumption rate, the marine environment is of special concern to the Japanese population. Therefore, the contamination of the marine environment was continuously monitored both at the discharge areas of the reactors as well as at the offshore stations by TEPCO and by the Japanese authorities.

The Agency's Environment Laboratories in Monaco reviewed information regarding impacts on marine life and seafood resulting from the thousands of tonnes of radioactively contaminated water used to cool the reactors that had been released into the Pacific Ocean. The Agency also advised Japan on the collection of marine samples and reviewed a marine monitoring programme in Japan. It also participated in an analysis campaign initiated by the US Woods Hole Oceanographic Institution to collect water and biota samples between Japanese waters and Hawaii in June 2011.

<sup>2</sup> The Analytical Laboratories for the Measurement of Environmental Radioactivity (ALMERA) network comprises 122 laboratories from 77 States.

A delegation of major shipping lines met with the Agency and the International Maritime Organization in May 2011 to discuss ways of monitoring containers at ports. Support was provided to the shipping companies through the Agency's Denial of Shipment Network.

By agreement with the Government of Japan, the Agency assembled a team of experts who undertook an 'IAEA International Fact Finding Expert Mission' from 24 May to 2 June 2011 to identify initial lessons to be learned from the Fukushima Daiichi accident and to share this information with the world nuclear community. During the mission, the team of international nuclear experts received information from many relevant Japanese ministries, nuclear regulators and operators. The mission also visited three of the affected nuclear power plants – Tokai Daini, Fukushima Daini and Fukushima Daiichi – to gain an appreciation of the status of the plants and the scale of the damage. The visits allowed the experts to talk to the operator staff as well as to view the ongoing restoration and remediation work. The

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results of this mission were discussed with Japanese experts and officials, and a mission report was submitted to the Ministerial Conference on Nuclear Safety mentioned below.

The Director General convened a Ministerial Conference on Nuclear Safety in Vienna, from 20 to 24 June 2011, to draw on the lessons from the Fukushima Daiichi accident in order to strengthen nuclear safety throughout the world. The conference provided an opportunity to undertake, at the ministerial and senior technical level, a preliminary assessment of the accident and discussed broader issues relating to nuclear safety, emergency preparedness and response, and the international legal framework. The Conference unanimously adopted a Ministerial Declaration, which, inter alia, requested the IAEA Director General to prepare a draft Action Plan on Nuclear Safety.

At the 55th regular session of the Agency's General Conference in September, Member States

unanimously endorsed the Board's approval of the IAEA Action Plan on Nuclear Safety, which was prepared in consultation with Member States.

The Director General established a dedicated 'Nuclear Safety Action Team' in the Secretariat to ensure proper coordination among all stakeholders and to oversee the prompt implementation of the Action Plan. This team developed a strategy to implement the activities within the scope of the Action Plan, initiating a detailed schedule of activities covering 12 actions, 39 sub-actions and 170 activities aimed at strengthening global nuclear safety. The Director General submitted a first progress report on the implementation of the Action Plan to the Board of Governors in November 2011.

At the request of the Japanese Government, the Agency sent an international expert mission to Japan from 7 to 14 October 2011 to help develop remediation plans. The mission's final report was issued to the Japanese Government on 15 November 2011 and was made publicly available.

Based on the lessons learned from the Fukushima Daiichi accident, the Agency began to re-evaluate the range of safety and security peer reviews and advisory services it offers to Member States, with a view to strengthening them.

Taking into account existing experience, the Agency developed a methodology for assessing the safety vulnerabilities of a nuclear power plant and made it available for Member States to assist them in completing a systematic analysis of the impact of extreme natural hazards at a nuclear power plant.

The Agency is in the process of extending its design review service to include modules for the peer review of national assessments that have been carried out by Member States. This service focuses on the design and safety assessment aspects of protection against extreme events, including defence in depth.

To strengthen the effectiveness of national regulatory bodies, and to enhance the Integrated Regulatory Review Service (IRRS), a 'Fukushima module' was incorporated into the scope of IRRS missions to take account of the initial regulatory implications of the accident. The Director General proposed closer cooperation with WANO, stating that the two organizations should continue to exchange information regarding the results of their respective peer review activities, where confidentiality constraints permit.

The Secretariat reviewed the Agency's safety standards, covering, as a first priority, the set of Safety Requirements applicable to nuclear power

plants and the storage of spent fuel. The draft Safety Standards Action Plan was approved by the Commission on Safety Standards. The plan will be continuously updated as further lessons continue to be learned in this regard.

The Agency also continued to assist Member States in strengthening and maintaining their capacity building programmes. The main issues considered were education and training, human resources, knowledge management and knowledge networks. The Agency also began development of a self-assessment methodology for capacity building programmes.

Another priority is to enhance the transparency and effectiveness of communication and to improve the dissemination of information. In addition, the Agency initiated a review of the application of INES as a communication tool.

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